

## Appendix

Species of pigeons for which the sternum was examined. *Caloenas nicobarica*; *Chalcophaps indica*; *Columba*: *leucomela*, *livia*, *vitiensis*; *Didunculus strigirostris*; *Drepanoptila holosericea*; *Ducula*: *bicolor*, *concinna*, *mullerii*, *whartoni*; *Gallicolumba*: *jobiensis*, *luzonica*; *Geopelia*: *cuneata*, *humeralis*, *striata*; *Geophaps*: *plumifera*, *scripta*, *smithii*; *Goura cristata*; *Gymnophaps albertisii*; *Hemiphaga novaeseelandiae*; *Henicophaps albifrons*; *Leucosarcia melanoleuca*; *Lopholaimus antarcticus*; *Macropygia amboinensis*; *Ocyphaps lophotes*; *Otidiphaps nobilis*; *Petrophassa albipennis*, *rufipennis*; *Phaps*: *chalconotus*, *elegans*, *historionica*; *Ptilinopus*: *magnificus*, *regina*, *rivoli*, *superbus*; *Reinwardtoena reinwardtsi*; *Streptopelia*: *chinenis*, *risoria*; *Treron psittacea*; *Trugon terrestris*; *Zenaida auriculata*.

## A reassessment of the subspecies in the owl *Glaucidium tephronotum*, with notes on its biology

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The Red-chested Owlet *Glaucidium tephronotum* is a relatively little-known Afrotropical forest resident. Six subspecies, *tephronotum*, *pycrafti*, *medje*, *elgonense*, *lukolelae* and *kivuense*, have been described, of which only the first four have been retained by *The Birds of Africa* (Fry *et al.* 1988; hereafter referred to as *BoA*). After careful examination of 46 specimens, representing all known taxa (see Table 1), we have come to the conclusion that only the first three subspecies should be recognised.

This study became necessary because PH was confronted with the substantial differences in measurements and weights that exist between birds of West Africa and those of the Democratic Republic of Congo (Central Africa) and eastern Africa as published by several authors, here grouped in Table 2. Chapin (1932), Bannerman (1933, 1951) and Prigogine (1971) previously pointed out these differences. However, the treatment in *BoA* and the measurements given appear to be incomplete and partly inaccurate. One may further wonder why in this reference work the juvenile and immature remain undescribed, notwithstanding the presence of a young bird in the collections of the Koninklijk Museum voor Midden-Afrika, Tervuren (KMMA), which was indicated previously by Chapin (1939).

## Material and methods

A total of 46 specimens from seven collections were examined, including the six type specimens (Table 1). The material from KMMA includes four birds collected by PH and the type of *elgonense* (Granvik 1934). The material from KBIN includes the type of *kivuense* (Verheyen 1946), and the specimens from AMNH include the types of *medje* and *lukolelae* (Chapin 1932); this material and that from NMK, LACM and ZFMK was examined by PH and ML. BMNH specimens, including the types of *tephronotum* (Sharpe 1875) and *pycrafti* (Bates 1911a), were all examined by MA. All authors studied the four *tephronotum* skins from Liberia.

Our measurements (PH and MA) are shown in Table 3. The flattened left wing was measured with a ruler with a stop at zero. The tail and the graduation of the tail were measured with a thin ruler with the scale starting from the outer edge of one end, pushed against the root of the central tail feathers, as described by Svensson (1992). Wing and tail feathers were checked for wear and active moult, which was scored from 0 (old feather) to 5 (full grown new feather), as shown by Ginn & Melville (1983).

## Type locality of the species

Sharpe (1875) described *Glaucidium tephronotum* with alleged type locality "South America". In 1911 Bates described the taxon *Glaucidium pycrafti* from Biteye, Cameroon. Chapin (1921), realising that *tephronotum* was an African bird, *de facto* synonymized both names, because he corrected the type locality for *tephronotum* to "Biteye". Later, a specimen became known from Mampong, Ashanti, Gold Coast (now Ghana) (Bannerman 1934) and this locality was given

TABLE 1  
Specimens examined for this study

Nominal subspecies	Total	Ad. male	Ad. female	Imm. male	Imm. female	Juv.	Unsexed adults
<i>tephronotum</i>	6	3	2	—	—	—	1
<i>pycrafti</i>	4	3	—	—	—	1	—
<i>medje</i>	33	15	5	3	6	2	2
<i>elgonense</i>	1	—	1	—	—	—	—
<i>lukolelae</i>	1	—	1	—	—	—	—
<i>kivuense</i>	1	1	—	—	—	—	—
Totals	46	22	9	3	6	3	3

The specimens were examined in the following museums: Koninklijk Museum voor Midden-Afrika (KMMA), Tervuren (21); Koninklijk Belgisch Instituut voor Natuurwetenschappen (KBIN), Brussels (4); American Museum of Natural History (AMNH), New York (6); National Museums of Kenya (NMK), Nairobi (2); the Natural History Museum (BMNH), Tring (10); Los Angeles County Museum of Natural History (LACM), Los Angeles (2); Zoologisches Forschungsinstitut und Museum Alexander Koenig (ZFMK), Bonn (1).

TABLE 2  
Published measurements (in mm) and mass (in grams) of *Glaucidium tephronotum*

Nominal subspecies	sex	wing	tail	mass	source
<i>tephronotum</i>	M (3)	102, 103, 105	61, 62, 70	—, 79.6, 85.3	Colston & Curry-Lindahl 1986
	F (1)	105	60	75.3	Colston & Curry-Lindahl 1986
<i>pycrafti</i>	M (3)	102–109	64–72	—	Bates 1930
	M (2)	103, 109	67, 68	—	Chapin 1932
	M (1)	103	66	71	Eisentraut 1963
	F (1)	106	—	73	Eisentraut 1963
<i>medje</i>	M (1)	116	83	—	Chapin 1932
	Dem. Rep. Congo	F (2)	116, 121	82, 87	—
Uganda	M (5)	116–121	82–87	—	Chapin 1939
	M (3)	—	—	80, 87, 93	Friedmann & Williams 1968
	M (2)	—	—	83.5, 94	Friedmann & Williams 1970
	F (1)	115	85	103	Friedmann & Williams 1970
	M (8)	112–119	80–88	—	Friedmann & Williams 1970
	M (1)	—	—	95	Friedmann & Williams 1971
	F (1)	118	86.5	100	Zimmerman 1972
	M? (1)	116	—	88	Britton in Zimmerman 1972
Kenya	F (1)	121	85 (worn)	—	Ripley & Bond 1971
<i>lukolelae</i>	F (1)	127	95	—	Chapin 1932
<i>kivuense</i>	M (1)	113	81	—	Verheyen 1946
<i>elgonense</i>	F (1)	124	104	—	Granvik 1934
	same	127	92	—	Chapin 1939

as the type locality for the nominate form in *BoA*. However, because it is best to separate *tephronotum* and *pycrafti* subspecifically, this action can be accepted as the designation of a newly chosen type locality for *tephronotum*. The type locality “West Africa” as used by several authors (following Peters 1940) is too vague in any case.

### Status and distribution

The status of the Red-chested Owlet has been described as uncommon to rare. Since the publication of *BoA*, the species has been recorded in several new localities, extending its formerly known range. It was found in Gola Forest, Sierra Leone, where it occurred in primary forest and was described as rare; this constitutes the most westerly record of the species (Allport *et al.* 1989). In Ivory Coast, where the species was formerly only known from Tai, it was also found in the managed forest of Mopri, in the centre of the country, and in Yapo Forest in the east

TABLE 3  
 Authors' measurements (in mm) and mass (in grams) of *Glaucidium tephronotum*

Nominal subspecies	sex	wing	tail	mass	
<i>tephronotum</i>	M (3)	102–105	64–68 (2)	79.6, 85.3	BMNH
	F (2)	104, 104	64, 64 (1)	75.3	BMNH
	—(1)	105	68		BMNH
<i>pycrafti</i>	M (3)	100, 104, 109	63, 66, 66		BMNH
<i>medje</i>	M (12)	113–120	80–89 (3)	102, 111*, 115*	KMMA
Dem. Rep. Congo	mean	116.8	83.9		
Kenya	M (2) imm	114, 117	83, 86 (1)	85	
	F (2)	124, 126	92, 82		
	F (4)	112, 116, 117, 127	81, 85, 86, 99		
Kenya	—(1)	120	89	84	NMK
	—(1)	112 (right wing)	78		NMK
<i>elgonense</i>	F (1)	124	93 (from beneath) 104 (from above)		

\*stomach contents of 40 g in both birds.

(Gartshore *et al.* 1995, Demey & Fishpool 1994). These records, together with those from Liberia and Ghana (Gatter 1988, Grimes 1987), suggest that the species occurs throughout the Upper Guinea forest block. They indicate, moreover, that the species is not restricted to primary forest but can survive in secondary forest. In the Lower Guinea forest block, it was known to occur in southern Cameroon, Democratic Republic of Congo and Western Uganda (see above); it has recently been found in the Mayombe, Congo-Brazzaville (Dowsett-Lemaire & Dowsett 1989). A third population occurs from extreme eastern Uganda to western Kenya (Mount Elgon and Kakamega—Lewis & Pomeroy 1989).

### Description of nominal subspecies

From relevant literature and our own examination, we describe here the nominal subspecies:

*tephronotum*: breast white with large dark brown spots to feather tips (*BoA*), spots of underparts rufous shaded with dusky (Chapin 1932, 1939). In the 4 birds from Mount Nimba, the spots on the underparts are ovate (length 5–10 mm) and light rufous grey in the hand, but do look darker from a distance. In dorsal view the nominate specimens (including the type) have greyer heads and also (though not as clearly), a less rufous back than on the 3 *pycrafti* specimens. The slate-grey upperparts of the 4 birds from Liberia match the colour of the upside of 8 Congolese birds (from Equateur, Ubangi, Uele and Kasai), but in 6 other Congolese birds (all from Kivu) and 1 from Rwanda the dorsal side looks a little darker.



*pycrafti*: underparts (centre of chest, breast and belly) whitish-buff, each feather with a large, terminal, round or oval spot of dark brown (Bates 1911a,b), sepia (Bannerman 1933), blackish (Chapin 1939), black (*BoA*), and large oval black spots, measuring  $5 \times 7$  mm on the flanks (Chapin 1932: 5).

Less rufous than the nominate race, especially down the flanks, the spots are also darker, having a more spherical, rather than tear-drop shape, giving a much bolder appearance; upperparts: dark umber-brown (Bates 1911a,b, 1930), dark chocolate brown (Bannerman 1933, *BoA*).

*medje*: underparts with black spots narrower and longer  $2.6 \times 8$  mm ( $3 \times 8$  mm in *lukolelae* Chapin 1932: 3–4), more heavily spotted with black (*BoA*); upperparts less brownish on crown and back (Chapin 1932). It is larger than *pycrafti*.

*lukolelae*: crown and back greyer than in *medje* or *pycrafti* (Chapin 1932); *lukolelae* is probably not separable from *medje* (White 1965).

*kivuense*: blackish spots larger and darker than in *medje* (Verheyen 1946); *kivuense* is probably not separable from *medje* (De Roo in Keith & Twomey 1968).

We consider the two forms above as individual variations within *medje*.

*elgonense*: underside pure clear white with large drop-shaped spots (colour of the spots not described by Granvik 1934); these spots are dark grey (blackish) and measure  $13 \times 5$  mm; head, back and upper surface of wings dark umber-brown as in *pycrafti* (Granvik 1934) (like *pycrafti* but darker brown above: Chapin 1939, *BoA*); female much larger than *pycrafti*.

In the literature, the plumage of the various populations of this owlet is described as follows:

*Wing*:

*pycrafti*: remiges blackish dark brown with umber-brown bars extending across both webs and becoming whitish-buff towards the margins of the inner webs (Bates 1911b).

*tephronotum*: remiges dusky brown (grey brown) with faint paler bars (also becoming whitish buff towards the margins of the inner webs (*BoA*)).

*medje* (type): remiges blackish brown, with whitish areas invading the inner webs, and, between these, obscure dusky bars (Chapin 1932).

*lukolelae* (type): remiges brownish black, their inner borders creamy white except near tips, and this whitish colour extending inward on the inner webs to form imperfect bars (Chapin 1932).

all primaries and secondaries obviously barred rufous (Zimmerman 1972).

We find the colour of the bars on the inner webs of the remiges varies from rufous (11 birds) fading to pale brown (11 birds), and being hardly visible in a further 6 birds.

According to *BoA*, upperwing coverts are dusky brown with a rufous wash in adult male *tephronotum*. In general the amount of these different tones of rufous in the wing feathers and on their coverts is very variable; it may be lacking, poorly visible or very conspicuous. The two nearly complete rufous birds (two females) fit into this overall picture: the first was collected on 17 July 1939 at Boende, Democratic Republic of Congo (0°14'S, 20°50'E), (KMMA 36.285); the second was obtained on 1 June or July 1926 at Mount Elgon, Kenya (1°06'N, 34°34'E), the type locality of *elgonense* (KMMA 115.895), to some 1,600 km from Boende to the ENE.

The alula and upperwing coverts have deep rufous margins of variable width and are indeed lacking in two birds (KMMA 114.818, male, 7 August 1954 Lusambo, Kasai and KMMA 74-44-A 460, female, 26 December 1953 Hembe, Kivu). The rufous margins may be restricted to one, two or six coverts (KMMA 59.288, male, 17 September 1951 Yokolo, Tshuapa; NMK 6406, undated Kakamega, Kenya; KMMA 91111, juvenile male 5 April 1956 Bolombo, Tshuapa).

#### *Tail:*

Dusky brown with 5 spots on the inner web of the three outer pairs (Bates 1911b), 6 spots in the type of *medje*, 4 spots in the type of *lukolelae* (Chapin 1932), and 4 spots on the three inner rectrices of which only 3 large spots (Bates 1911b) are conspicuous from above (*BoA*), the 4th at the base of the tail concealed under the upper tail coverts. Tail edged with very small whitish or light rufous spots or fringes on the inner web, which gradually wear off.

#### *Other parts:*

During a partial moult the sparsely streaked underside is replaced by a pattern of blackish drop-shaped (ovate, oval, teardrop-like) spots ( $2 \times 5$ – $10$  mm) of variable size (about  $2.6 \times 8$  mm at their largest in the type of *medje* and about  $3 \times 8$  mm in the type of *lukolelae*: Chapin 1932), the flanks and sides of the belly becoming gradually deep rufous. Also the shape of the spots is variable, in four birds (all KMMA 94.492 Boyagati, 93.007 Ibembo, 36285 Boende, 114.818 Lusambo) they are rather oval ( $8$ – $10 \times 4$  mm).

In some birds there is a marked colour difference between the dark grey head and the dusky brown mantle, back and rump but in full adult birds the upperparts are uniform deep dark grey. The dusky brown colour is probably caused by variable amount of rufous, wear or fading. In one male (not preserved, PH) the colour of the mouth was noted as blue grey.

A summary of the subspecific plumage differences is presented in Table 4.

TABLE 4  
Summary of description of the plumage of subspecies of *Glaucidium tephronotum*

	Spots (underside)	Flanks	Wings	Dorsal view
<i>tephronotum</i>	elongated oval, rufous	rufous	dusky grey-brown with dull-brown bars becoming whitish-buff towards margins of inner webs	dark slate-grey
<i>pycrafti</i>	round-oval, dark brown/black	whitish-buff with little rufous	blackish/dark brown with umber-brown bars becoming whitish-buff towards margins of inner webs	dark umber-brown
<i>medje</i> (incl. <i>lukolelae</i> , <i>elgonense</i> , and <i>kizwense</i> )	drop-shaped, blackish	deep rufous	blackish brown with whitish areas on inner webs and dusky bars; the colour of these bars varies from rufous fading to pale brown, being hardly visible in some birds	uniform deep dark grey in full adult birds

*Juvenile birds (from Democratic Republic of Congo):*

Downy young undescribed; down probably white. This is replaced by a white juvenile plumage (2 birds in KMMA: 18365, Buta undated; 47.594 Paulis 1949), which changes rapidly to an "immature" dress (3 birds in KMMA: 91.111, Bolombo-Buya 5 April 1956; 82747, Ikela 30 June 1956; 79.098, Lubumba, Kivu 9 October 1955); differing from the adult plumage as follows: underparts white, sparsely streaked blackish (3–5 mm long) to feather tips (only 2 streaks 7–8 mm long in the specimen of 5 April); no rufous on flanks (only a small amount of rufous on flanks: Zimmerman 1972), thighs and tarsi pale rufous or with a very small amount of rufous.

**Taxonomic conclusion**

Our study points to the existence of two distinct populations: smaller West African birds with very light rufous spots on the underparts, and larger eastern birds with dark brown, blackish or black spots. Within the western group, the specimens from Cameroon can be distinguished from those from the Upper Guinea forest block (nominate *tephronotum*) by their constant colour difference and we therefore agree with the recognition of these as a separate taxon *pycrafti*. The colour variations within the eastern group, on the other hand, are not geographically localised and we consider the more rufous birds, such as the type of *elgonense* (KMMA 115.895) and the specimen from Boende (KMMA 36.285), as rufous forms, a phenomenon not uncommon in owls. We therefore consider all eastern birds to form a single taxon, *medje*; the forms *lukolelae*, *kivuense* and *elgonense* are to be considered as synonyms of *medje*.

Our conclusion is that Red-chested Owlet comprises three subspecies: nominate *tephronotum* Sharpe in West Africa (Sierra Leone, Liberia, Ivory Coast and Ghana), *pycrafti* Bates in Cameroon and *medje* Chapin (including *lukolelae*, *elgonense* and *kivuense*) in Central Africa (Congo-Brazzaville, Congo, Rwanda, Uganda and Kenya). Further study is required (e.g. on vocalisations) to decide if the western and the eastern forms indeed form one species.

**Habitat, diurnal and altitudinal occurrence**

This owlet is at times diurnal, as shown by eight birds recorded or collected: 1 at about 0700 h, another at 1115 h, 2 birds about midday, 1 during daytime and 4 in late afternoon, including one before a tropical storm (see also Chapin 1939: one at 1500 h on a rainy day). There may be sexual difference in activity pattern and/or habitat because all the birds collected during day-time were males. All the recorded birds occurred at a height of 3–4 m in secondary forest or cultivated areas in the vicinity of human settlements, near local roads or paths. In some cases the presence of this owlet during daytime was discovered through the noise made by small birds mobbing it (Bates 1911a) or revealed by the alarm calls of Garden Bulbuls *Pycnonotus barbatus* or other small birds (PH, pers. obs.).



According to several authors (Chapin 1932, Bannerman 1934, Granvik 1934, Friedmann & Williams 1970, Prigogine 1971, Zimmerman 1972, Grimes 1987, Taylor & Taylor 1988) females were trapped or shot in "mature forest, thick forest, across forest road, *galerie forestière d'altitude*, heavy forest (Kakamega), calling or heard in undisturbed forest, in the undergrowth in both primary forest and areas where trees had been heavily exploited".

Nine birds from Kivu were recorded between 950 and 2,040 m (Prigogine 1971, Verheyen 1946: KBIN) and one at 1,900 m in Rwanda (KBIN); according to Britton (1980) the maximum altitude is 2,150 m.

### Food and body mass

This owlet feeds largely "on small animals including rats, birds and insects including bugs" (*BoA*), frogs, snails (Eisentraut 1963), seeds (Friedmann & Williams 1968) (possibly from a songbird gizzard ?), butterfly eggs and (recorded twice) a rat (40 g) (Equateur, Democratic Republic Congo). We cannot agree with Burton's (1984) judgement that this owlet attacks mammals and birds "considerably bigger than itself". The masses of the two males (with a rat of 40 g in their stomachs) were 111 g and 115 g. Friedmann & Williams (1970) and Zimmerman (1972) recorded 103 g and 100 g for females. It is necessary to bear in mind the mass of food items when estimating body mass of the owls, and also possible differences between male and female owls (see analysis and discussion in Kemp 1989).

### Breeding and moult periods

In West Africa egg laying occurs in late February (Ghana) or earlier, as one immature male was recorded in Cameroon in wing moult (score left 29-right 22 points) on 30 January (ZFMK 61.1492). Adult birds may replace wing feathers some months later, as one male in Liberia scored 17 on 27 June. Birds in non-breeding condition were recorded in August (ovary 9 mm), September (testes 3 mm), January (one male, one female) and March (testes 9 mm).

In Central Africa the breeding seasons are somewhat different. For the purpose of this paper the Ubangi, Equateur, Uele and Ituri districts in the Democratic Republic of Congo are lumped to form one zone. In this large subdivision, juvenile birds were recorded on 5 April and 30 June, birds in active wing moult on 19 May (score 47) and 30 July (score 18) while 3 birds in fresh plumage and 4 others with slightly worn wing tips were found in the period May to July (one in Kasai in August). Thus breeding takes place from March to May, a few months later than in West Africa. One bird was in interrupted moult in June (score 35).

Another zone contains the more easterly localities in the Kivu province of the Democratic Republic of Congo, Rwanda, Uganda and Kenya. One female in breeding condition (ovary 30 × 25 mm) was collected in mid April (Kivu), one juvenile female recorded early July (Kenya) and two immatures with slightly worn wing tips on 23

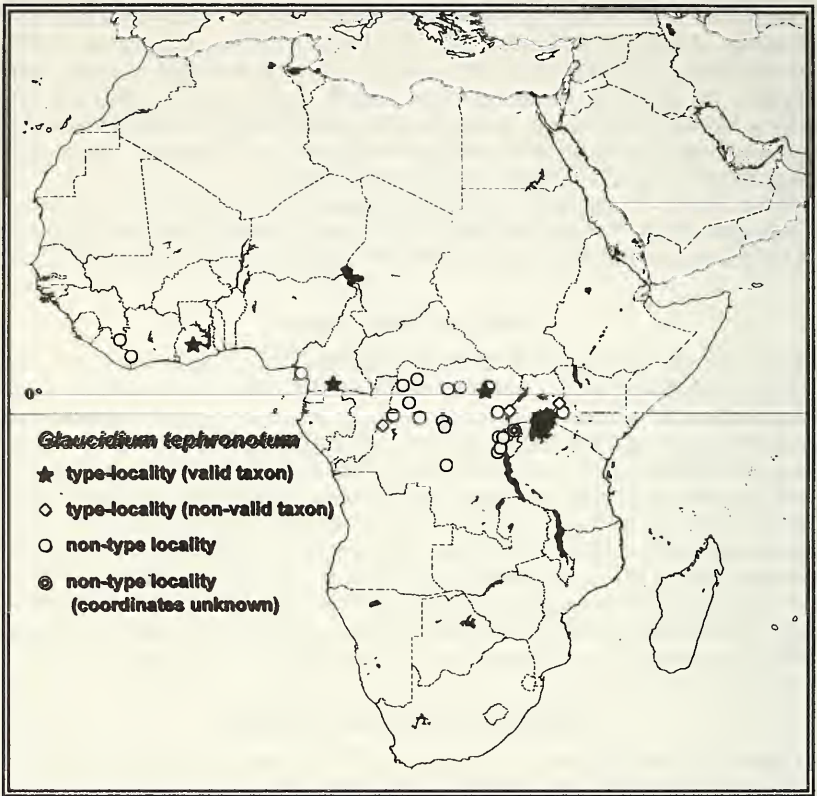


Figure 1. Localities of *Glaucidium tephronotum* specimens examined. Types of nominal (diamonds) and accepted (stars) subspecies; other specimens: open circles.

September and 9 October (Kivu). Six birds in non-breeding condition were collected in Uganda between 11 July and 10 December (4 in November) and one female in Kivu late December (fresh). Six males in fresh plumage or with slightly worn wing tips were obtained in the Kivu from April (testes 4 × 5 mm) to June, October and January, while one male from Rwanda and one from Kenya, both in March, showed slightly abraded wing tips. This would imply that in the eastern part of Africa breeding also occurs in April or May, perhaps a little later, but juveniles and specimens in wing moult are lacking to confirm this.

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## Ornithological surveys in the Cordillera Cocapata, depto. Cochabamba, Bolivia, a transition zone between humid and dry intermontane Andean habitats

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Recent studies of avian diversity in South America have mainly focused on lowland rainforest and Andean foothills. The analyses by Stotz *et al.* (1996) emphasize the sub-Andean zone as a priority for research and conservation in the light of the habitat changes which are occurring there today. However, this priority does not adequately consider the habitat loss which took place in the past at much higher altitudes. Fjeldså & Kessler (1996) suggest that Andean habitats above 3,500 m have been strongly influenced by man since early post-glacial times, and that less than 5% of the potential humid woodland habitat is left in this altitudinal zone. In general, the timberline is suppressed by at least 500 altitudinal metres, due mainly to the excessive use of fire to maintain open pasture habitats (Kessler 1995). This widespread degradation and lowering of the timberline in the tropical Andes has led to a considerable decline in population size of many bird species restricted to this ecotonal habitat (Kessler & Herzog 1998).

Other areas with a strong and long-lasting human influence are the montane basins (e.g., Cuzco, Cochabamba) and in particular the transition zone from the humid east-Andean slope to the rainshadowed intermontane valleys. In such places, the highest intensity of human use is centered around the most productive zone on the transition from the strongly mist-influenced upper slopes to the often dry lower slopes